REMARKS

Status of the Claims

Claims 1-4, 7-12 and 15 are pending. Claims 1-4 and 7 are withdrawn. Claims 8-12 and 15 are rejected. Claims 8-10 are amended herein. Claims 1-4, 7, 11-12, and 15 are canceled. No new matter has been added.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendments. The attached page is captioned "VERSION WITH MARKINGS TO SHOW CHANGES MADE". Reconsideration of the pending claims is respectfully requested.

Amendments to the claims

Amended claim 8 overcomes the rejection under 35 U.S.C. 103 as obvious over **Shang** *et al.*, in view of **Nicolas** and **Karwacki** *et al.* Claims 11-12 and 15 are incorporated into amended claim 8 to recite activating the fluorine gas via a radiofrequency energy source and further that electrolysis converts hydrofluoric acid to fluorine gas. Claim 8 is also amended to recite that the fluorine gas generator is on site with and connected to the

CVD system, but remote to the process chamber (Figs. 1-2). Additionally, claim 8 is amended to recite that after electrolysis the gas mixture containing hydrofluoric acid and fluorine is transferred to a cold trap which is connected to the generator and to the CVD system. Subsequent to generation of the fluorine gas it is delivered to a location in the CVD system suitable for activation of the fluorine via RF energy to clean the process chamber (pg. 7, ll. 7-15).

Claims 9 and 10 depend from independent claim 8 and are amended to clarify claim language. Claim 9 is amended to recite a further method step of pumping the fluorine cleaning gas to a storage unit prior to delivery of the fluorine to an activation location. Claim 10 is amended to clarify that the activation location is the process chamber or a location remote to the process chamber. Claims 1-7, 11-12 and 15 are canceled. No new matter is included in these amendments.

The 35 U.S.C. §103(a) rejections

Claims 8-12 and 15 are rejected under 35 U.S.C. §103(a) as being unpatentable over **Shang** et al. (U.S. 5,788,778) in view of

Nicolas (U.S. 5,284,605), and in further view of **Kawacki** et al. (U.S. 5,569,151). Applicants respectfully traverse this rejection.

The Examiner states that **Shang** *et al.* teaches a method of cleaning a deposition chamber by delivery of reactive gas, such as fluorine, into a remote plasma chamber located outside the deposition chamber, activating the reactive gas using microwave energy and flowing the activated reactive gas from the remote chamber into the deposition chamber to clean it (Abstract; col. 6, ll. 23-29). Further, that **Shang** *et al.* is silent about how the cleaning gas is obtained and stored is immaterial for the cleaning process per se, unless criticalities of such specific steps are provided.

Nicolas teaches that fluorine gas is generally obtained by electrolysis of anhydrous hydrofluoric acid and that the fluorine produced may carry some HF which may be an impurity (col. 1, ll. 17-24). Hydrofluoric acid is separated from the fluorine gas by refrigerating the gaseous mixture and by condensing the hydrofluoric acid to form a liquid to obtain a pure fluorine gas (col. 2, ll. 5-22). **Karwacki** *et al.* teaches filling, storing and delivery of fluorine to the processing site in a container approved by the Department of Transportation (col. 2, ll. 44-48; col. 3, ll. 52-60).

Thus a person skilled in the art would have found it obvious to obtain purified fluorine as per **Nicolas** and to deliver it to the processing site of **Shang** *et al.* in the safe container of **Karwacki** *et al.* in order to facilitate the process of **Shang** with reasonable expectation of success. The Examiner further states that with regard to the specific limitation of claim 8 in reciting "generating a fluorine cleaning gas on site with but remote to the process chamber" a person skilled in the art would have found it obvious to generate or obtain the cleaning gas from the source which is located as close as possible to the subject to be cleaned in order to cut down or eliminate additional expesnses related to transportation and distribution of hazardous gaseous materials such as fluorine gas.

Shang *et al.*, **Nicolas** and **Karwacki** *et al.* are as stated in the response filed October 30, 2002. Applicants' invention is as discussed *supra*. Applicants have canceled claims 11-12 and 15. Applicants have amended independent claim 8 as discussed *supra*. Further to the comments provided in the previous response, Applicants wish to reiterate that **Shang** *et al.* teach a process of cleaning a deposition chamber by activating a reactive gas in a remote chamber via a high power microwave source to form reactive species such as chlorine or fluorine radicals. As stated

supra, claim 8 is amended to recite activation of fluorine gas via a radiofrequency energy source.

With regard to the Examiner's assertions about generating or obtaining the cleaning gas, Applicant's submit that it may be obvious to obtain the cleaning gas from a source as close to the apparatus to be cleaned as possible; e.g., **Shang** *et al.* use a gas supply system connected to the remote chamber via a valve and controller system to supply chlorine, fluorine, NF_3, CF_4, SF_6, C_2F_6, CCl_4, or C_2Cl_6 cleaning gas (col. 4, ll. 31-47; col. 6, ll. 23-31). However, it is not obvious to generate a fluorine cleaning gas from non cleaning hydrofluorice acid on site by combining the teachings in **Shang** *et al.* with **Nicolas**. Additionally, the Examiner appears to be using the words generating and obtaining synonomously as in to acquire from an outside source. This is corroborated by the Examiner's statement that it is obvious to obtain purified fluorine as per **Nicolas** and to deliver it to the processing site of **Shang** *et al.* in the safe container of **Karwacki** *et al.*

Applicants' claim 8 specifically recites generating fluorine gas on site and further recites how the fluorine gas is generated. The use of hydrofluoric acid for the on site generation of fluorine cleaning gas provides a cheaper, less environmentally

impacting and safer method of cleaning the process chamber. Transporting fluorine gas, whether obtained via the method in **Nicolas** or not, in the safe container of **Karwacki** *et al.* may improve the method of **Shang** *et al.* in safer fluorine gas handling, but it does not suggest generating fluorine gas on site with and to be used in the system in **Shang** *et al.*

The Examiner states that a "new" process can still be obvious when considered as a whole notwithstanding that specific starting materials are not disclosed in the prior art. However, **Shang** *et al.* could not use HF as a starting material within the metes and bounds of the invention taught therein. HF is considered a non-cleaning gas even though fluorine radicals can be generated with the application of energy because the fluorine radicals would recombine with the hydrogen before any cleaning could be accomplished. **Shang** *et al.* teach the use of any commonly used reactive halogens and halogen compounds, the choice of which is determined by the deposited material to be removed. As such, no motivation is found to limit the system to fluorine gas nor to generate on-site fluorine gas from hydrofluoric acid.

In considering the Examiner's statement that it would be obvious to obtain pure fluorine gas as disclosed in **Nicolas**, Applicants wish to point out that **Nicolas** does not fairly teach that the recovered gas from the refrigeration process is pure fluorine. **Nicolas** uses fluorine gas obtained by electrolysis of hydrofluoric acid which is known to contain 5-15% by volume of HF which may be an impurity (col. 1, ll. 17-24). This fluorine gas is used in a combustion process to produce uranium fluorides without first removing the residual HF from the fluorine gas.

Refrigeration of the combustion products is to primarily separate HF and the uranium fluorides through condensation. The gas remaining is a mixture of the fluorine gas and the non-condensable gases, such as nitrogen and oxygen, necessarily resulting from the combustion process and which may contain traces of HF, in excess of the stoichiometric amount required for the combustion of uranium. The intent is to reuse this gas in the combustion process or to compress it for later use; no suggestion is found that these gases as such can be used in other methods. To separate the non-condensable gases from the fluorine gas requires reacting the gas mixture with potassium hydroxide to produce potassium fluoride (col. 3, ll. 14-24; col. 5, ll. 29-36).

In considering **Karwacki** *et al.* the instant invention as recited in amended claim 8, the fluorine gas is delivered from the cold trap to an activation location when the chamber is cleaned. This minimizes the need for storage of the gas particularly as using a temporary storage container after removing the fluorine gas from the cold trap is optional. Therefore, the instant invention as recited in amended independent claim 8 obviates the need for a transport and storage system for fluorine gas as disclosed in **Karwacki** *et al.* Should temporary storage of the fluorine gas be necessary prior to activation thereof, a storage container is connected to the cold trap. Additionally, as pumping the fluorine gas to a storage unit is a limitation of a claim dependent on amended claim 8, combining **Karwacki** *et al.* with **Shang** *et al.* does not render the invention obvious in view of Applicants' assertions that **Shang** *et al.* does not render the invention obvious.

Applicants submit that in determining obviousness one must consider what elements of the invention are fairly taught in the prior art. Furthermore, there must be a suggestion, teaching or motivation to make the combination with a reasonable expectation of success. In comparing the prior art cited herein to the amended

claims, what is obvious is what is not taught in the prior art. **Shang** *et al.* does not teach RF energy to form fluorine radicals nor does **Shang** *et al.* teach or suggest the use of a non-reactive gas from which to generate the reactive gas. **Nicolas** does not teach that the condensation method used therein generates pure fluorine gas nor that the non-condensable fluorine gas mixture obtained via condensation can be used in any other method.

Absent these elements, a combination of **Shang** *et al.* and **Nicolas** can not render the instant invention obvious. As such, neither can combining **Karwacki** *et al.* with **Shang** *et al.* or **Shang** *et al.* and **Nicolas** render the instant invention obvious for reasons stated supra. Thus, the invention as a whole was not obvious to one of ordinary skill in the art at the time the invention was made. Accordingly, Applicants respectfully request that the rejection of claims 8-12 and 15 under 35 U.S.C. §103(a) be withdrawn.

This is intended to be a complete response to the Final Office Action mailed January 29, 2003. If any issues remain outstanding, the Examiner is respectfully requested to telephone the undersigned attorney of record for immediate resolution. Applicants believe that no fees are due, however, should this be in

error, please debit Deposit Account No. 07-1185 on which the undersigned is allowed to draw.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please amend claim 8 as follows:

8. (twice-amended) A method for cleaning a process chamber in a CVD system for semiconductor and/or flat panel display manufacturing using hydrofluoric acid as a non-cleaning precursor gas, comprising the steps of:

generating a fluorine cleaning gas from said hydrofluoric acid via a fluorine gas generator, said fluorine gas generator on-site with and connected to the CVD system but remote to the process chamber in the CVD system, said generating step comprising:

converting hydrofluoric acid in said generator to a gas mixture of said hydrofluoric acid and said fluorine gas via electrolysis;

transferring the gas mixture to a cold trap directly connected to said generator, said cold trap further comprising means to connect to the CVD system; ~~and~~

converting said hydrofluoric acid gas into a liquid,

removing said liquid hydrofluoric acid from the cold trap to said generator, said fluorine cleaning gas remaining in a gaseous form; and

delivering said fluorine gas via said connecting means to a location in the CVD system suitable for activation of said fluorine gas;

activating said fluorine cleaning gas via a radiofrequency energy source to form a plasma of fluorine radicals; and

cleaning ~~to clean~~ the process chamber with said activated fluorine radicals.

Please amend claim 9 as follows:

9. (twice-amended) The method of claim 8, ~~wherein~~ further comprising the step of:

pumping said fluorine cleaning gas ~~is pumped~~ into a storage unit prior to said ~~activating~~ delivery step.

Please amend claim 10 as follows:

10. (amended) The method of claim 8, wherein said ~~fluorine cleaning gas~~ location suitable for activating ~~is activated to form~~ said fluorine radicals ~~inside~~ is the process chamber or ~~wherein said fluorine cleaning gas is activated to form fluorine radicals~~ a remote location outside the process chamber, said fluorine radicals subsequently delivered to the process chamber.

Please cancel claims 1-7, 11-12 and 15.

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